Reaction Rate Case Study

**1. What is biomass?**

**2. How is biomass used in industry?**

**3. What is the advantage of using biomass instead of more traditional materials such as petroleum?**

**4. What happens inside a biorefinery?**

**Ethanol can be mixed into gasoline to reduce the amount of harmful pollutants released in car emissions. To ensure that ethanol actually remains a “greener” method, the process to create it must be as environmentally friendly as possible. Vitaly Budarin and associates created a chemical catalyst that allows for ethanol (C2H5OH) to be created from succinic acid (C4H6O4) in aqueous solutions more rapidly than other methods. They performed an experiment to measure the reaction time of succinic acid. They measured the change in concentration of succinic acid over time.**

**The rate of reaction measures how fast a reaction is occurring.**

**5. What are some examples of reactions with slow reaction rates?**

**6. What are some examples of reactions with fast reaction rates?**

**The units of reaction rate can vary. Some examples include mol/min & mL/s. The one we will use most often is mol/(L•s) . In this case study we will use mol/(L•min) because of the longer reaction time.**

**r - average rate of reaction Δc – change in concentration Δt – change in time**

**7. Given the following experimental data, what is the average rate of reaction in the first 50 minutes of the reaction? What is the average rate of reaction between the 100th and 200th minute of the reaction?**

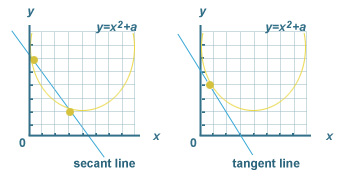
Table 1: Concentration of succinic

acid over time

|  |  |
| --- | --- |
| **Time**  **(min)** | **Concentration**  **(mol/L)** |
| 0 | 0.5080 |
| 50 | 0.3099 |
| 100 | 0.2032 |
| 150 | 0.1321 |
| 200 | 0.0914 |
| 250 | 0.0559 |
| 300 | 0.0305 |
| 350 | 0.0102 |
| 400 | 0.0025 |

**8. Explain the differences in rates between these two time periods.**

**We can also use graphs to determine the rate of reaction by drawing tangent lines and secant lines to the reaction curve.**

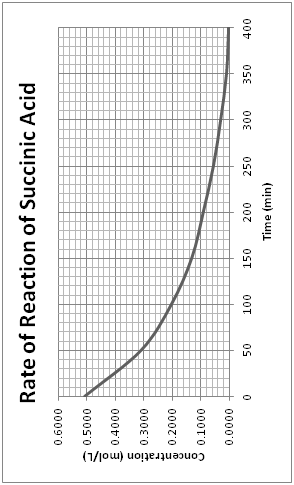


**9. Use the graph on the next page to draw a secant and determine the average reaction rate between 80 and 160 minutes.**

**10. Draw a tangent line to determine the *instantaneous* rate of reaction at 30 minutes.**

**11. Draw a secant to find the average reaction rate between 0 and 400 minutes.**

**12. How accurately does the reaction rate you calculated in question 11 reflect the actual reaction process? Explain your answer.**

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